FISHERIES OF INLAND WATER BODIES IN MALAYSIA

Khoo, K. H., Amir, S. R. M. S. & Ali, A. B.*
School of Biological Sciences, Universiti Sains Malaysia
Penang, Malaysia

1.0 Introduction

Malaysia covers an area of about 336,700 square kilometers and comprises the Malay Peninsula known as Peninsular Malaysia and the northwestern part of Borneo Island known as Sabah and Sarawak. The two parts are separated by about 645 km of the South China Sea. Temperature and humidity is always high. The average rainfall is 245 cm a year.

Peninsular Malaysia, covering an area of about 154,680 km^2, has a series of mountain ranges, the highest peak being Gunung Tahan (2,190 meters). The heavy tropical rainfall gives rise to many rivers, the largest of which are the Sungai Kelantan, Sungai Pahang (459 km) and Sungai Perak (522 km).

Sabah and Sarawak has an area of 202,020 km^2 and are crisscrossed by low mountains. Sabah has a narrow coastal plain that gives way to a mountainous jungle-covered interior with Mount Kinabalu rising to 4,103 meters being Malaysia's highest peak. Other high peaks are Mount Trus Madi (2,591 meters) in Sabah and Mount Murud (2,438 meters) in Sarawak. Sarawak has a broad alluvial coastal plain crossed by a number of rivers. The more important rivers in Sarawak are the Sarawak (115 km long), the Batang Lupar (228 km), the Rajang (565 km), the Baram (402 km) and the Limbang (196 km). In Sabah the important rivers are the Kinabatangan (565 km), the Sungut, the Lubuk, the Segama, and the Padas River. Yap (1992) reported yields for four principal rivers: Rajang (Sarawak, 100 kg/ha/year); Baram (Sarawak, 142-169 kg/ha/year; Gombak (Selangor, 180 kg/ha/year), Perak (Perak, 11.64 kg/ha/year).

Lotic waters dominate the Malaysian aquatic environment. There are very few natural lakes in Malaysia. There are only two principal lenthic environments in Malaysia. They are Tasek Chini and the Tasek Bera/Tasek Dampar complex. Both of these lakes located in Pahang, are relatively small in size. Tasik Bera is more of a freshwater swamp than a true lake, covered with stands of littoral, floating, emergent and submerge vegetation, such as *Lepironia articulata* and *Pandanus helicopus,* and very few truly open water spaces (Furtado & Mori, 1982). They reported 95 species of fishes from Tasik Bera. Almost all of these species were endemic to Peninsular Malaysia. They also highlighted the difficulties of estimating fish abundance in Tasik Bera because of the small size of fish, presence of large numbers of refuges where the fish are inaccessible and the low intensity of fish catches by the natives.

Tasik Chini consists primarily of water bodies joined together to form a string of small lakes (Ali, 1988). Other small bodies of water, either permanent or semi-permanent, such as the Paya Bungur and Tasik Beringin, are more shallow wetland ecosystems than lakes (Fatimah *et al.*, 1984, Nather Khan, 1990).

Man-made lakes or reservoir dominates the Malaysian lentic environment. In Malaysia, there are 63 large impoundments with a total storage of 25 billion m^3 ranging in size from 10 ha (Mahang Dam) to 37 000 ha (Kenyir Dam) and 150 major river systems (100 in Peninsular Malaysia, more than 50 in Sabah and Sarawak (Mohd. Azhar 2000). Currently the largest reservoir is Tasik Kenyir that has a surface area of 36.9 km^2. Other major impoundments, that are those larger than 10 km^2, are presented in Table 1. These large impoundments were building either for irrigation or hydroelectric power generation. In some, as indicated in Table 1 they have an additional role in flood mitigation. The rest of the man-made lentic environment comprises small reservoirs whose main functions are flood mitigation, irrigation, domestic and industrial water supplies. These small reservoirs do not support a fishery. The current estimate of the total Malaysian lentic environment is about 1000 km^2, with another 1000 km^2 in the planning or implementing stages.

Khoo *et al.* (1987) reported that inland capture fisheries in Malaysia are dominated by cyprinids and silurids in the country's larger river systems, and that there have been sharp declines in catches during recent decades. These declines are attributable to a combination of factors, including river regulation (particularly dewatering of stream reaches below dams), (Jackson & Marmulla, 2001) and pollution, siltation, damming, illegal gear/methods, and overfishing (Khoo *et al.* 1987). In the Selangor River, flows have been reduced from 5 482 000 m^3/day to 300 000 m^3/day and in Sabah, the release from the Babagon Reservoir dam has reduced streamflow to 5.5-21.0% of the natural river flow (Yap 1992).

2.0 Limnology of Malaysian Reservoirs

In general, the physico-chemical properties of natural Malaysian lakes and reservoirs are favorable to fisheries development. A lentic environment usually acts as a settling basin thereby reducing the turbidity of water. Hence, light penetration is deeper than in river conditions leading to greater productivity. An example of the physico-chemical properties of a typical reservoir, Tasek Chenderoh is presented in Table 2 (Ali 1996).

The concentration of dissolved oxygen in a shallow reservoir such as Tasek Chenderoh varies from 2,5 to 9.5 mg/L. There is a decreasing gradient in dissolved oxygen level with the low levels being detected near the bottom of the impoundment. In a deep reservoir such as Tasek Kenyir, a characteristic dissolved oxygen profile was observed. There is a sharp stratification of dissolved oxygen level between 7 m and 8 m depths. The environment below this depth was anaerobic. This is caused by the decomposition of decaying vegetation. Within the anaerobic environment, high levels of sulphide were detected. This anaerobic zone is not conducive to fisheries development and may have an adverse effect on the fishes in the lake.

Table 1: Major Impoundments (above 10 km^2) in Malaysia.

Name	Function*	Completion Date	Area (km^2)	Estimated Fish Yield (ton)
Chenderoh	HY/FM	1929	25.0	300
Bukit Merah	IR	1934	35.2	100
Ringlet	HY	1956	56.0	Nil
Pedu	IR	1972	64.0	Negligible
Muda	IR	1972	25.6	50
Temenggor	HY/FM	1978	152.0	100
Kenering	HY/FM	1983	60.0	100
Kenyir	HY/FM	1985	369.0	500
Pergau	HY			

- IR - irrigation
- HY - hydropower
- FM - flood mitigation

Table 2: Summaries of Water Quality Parameters for Chenderoh Reservoir and the Downstream Area (Ali, 1996)

Water Quality Parameters	Chenderoh Reservoir (1994)	Chenderoh Downstream (1986)
Mean depth (m)	3.7 - 4.0	0.3 - 3.0
Surface current (m/s)	0.3	0.5
Temp. (°C)	26.9 - 29.4	28.0 - 31.0
PH	6.0 - 6.9	6.2 - 7.6
Conductivity (μs/cm)	24 - 66	40 - 70
Dissolved Oxygen (mg/L)	3.9 - 6.7	6.0 - 8.5
Secchi Disk (m)	0.6 - 1.7	-
Total suspended solids (mg/L)	3.3 - 9.3	54 - 134
Ortho-phosphate (mg/L)	0.775	0.01 - 0.069
Nitrate	3.982	0.9 - 1.544

3.0 Capture Fisheries

These reservoirs, which were constructed for hydropower generation, irrigation or flood mitigation, have always contributed towards the inland fisheries of Malaysia. Its contribution towards the total fish landings in Malaysia is poorly documented. Until very recently there were very limited concerted efforts towards the management or monitoring of reservoir and lake fisheries in Malaysia. It is only in the past few years that the importance of studying and monitoring fisheries in the impounded waters was realized.

The contribution and status of the fisheries in there Malaysian reservoirs vary quite a bit. The smaller reservoirs especially those constructed for domestic and industrial water supplies do not support any fisheries. This is a consequence of a policy to prohibit fishing and other activities in the reservoirs so as to ensure the quality of the water.

Some tropical fish exhibit the same migratory breeding behavior as their relatives in temperate countries. Species such as *Helostoma temmincki, Leptobarbus hoevenii, B. schwanenfeldii* and *Thynnichthys vaillanti* are known to migrate during the breeding season that coincides with the flooding of river banks (Christensen 1992). In the upper Perak River, breeding schools of *T. thynnoides* have been observed to migrate in the Rui River system, which is in the upper reaches of the Bersia Reservoir, during the wet season of October to November. Other species reported to migrate during spawning season include *H. macrolepidota.* Lack of knowledge concerning the migratory behavior of tropical fish species has resulted in the construction of dams without facilities for fish to proceed to the breeding grounds beyond. Many local fish populations are on the verge of disappearing from large tropical river systems due to their inability to spawn properly. Thus, further studies are needed to study the migratory behavior and patterns of tropical fish especially in the context of spatial and temporal characteristics of these migratory runs.

In Malaysia, dams not only obstruct the migration of fish but also the migration of the giant freshwater prawn, *Macrobrachium rosenbergi.* This freshwater prawn normally breeds in brackish waters at the estuaries. After metamorphosis they migrate upstream, sometimes a few hundred kilometers inland such as in the upper reaches of the Pahang and Kelantan rivers. In the Perak river system they are only found below the Chenderoh dam.

Not all effects of dams are deleterious, the construction of a dam results in the creation of a reservoir with increase water area for fish production. In most Malaysian reservoirs the increase fish production have benefited the rural population residing near the reservoir, here are problems of overexploitation and use of illegal gears in some reservoirs. In some Malaysian reservoirs environmental problems have significantly reduced fish production and in the case of Ringlet reservoir it has no fisheries production at all.

3.1 First Estimates

Morphoedaphic Index concept and technique was first developed and introduced by Ryther (1965) to estimate fish productivity in Northern Temperate lakes and impoundments. He established the relationship between these temperate lakes where adequate data existed and fish yield. Subsequent to this there were many attempts to use this empirical method as well as others to estimate potential fish yields from impoundments, compelling Ryther *et al.* (1974) to discuss the use and abuse of this method. This empirical method provides an estimate of fishery potentials of lakes and reservoirs especially during the early stages of development.

Morphoedaphic Index formulations vary with climatic zones (Henderson *et al.*, 1973), thus it is essential that the appropriate formula be used. The concept in the MEI methodology is that they provide first estimates of the potential fish yields from impoundment especially new ones where there are very little previous studies on it and no existing fishery to provide details of fish yields. This is most appropriate, as we have seen some very wild projections of potential fish yields by foreign consultants doing EIA's on new dams in this region. These foreign consultants tend to boost the proposed fish production to enhance the value of the proposals. Unfortunately, these are just extreme projections without adequate basis. The morphoedaphic index methodology provides fishery biologist a method to evaluate these wild projections on new reservoirs. They also provide fishery biologist a very quick method to provide rough estimates of potential yield from new reservoirs and the level of fishery infrastructure needed to support the new fishery. This will ensure that there will not be overcapitalization of fishery development, which will be the case if the fishery scientists were to depend exclusively on the EIA of some of these proposals.

For the tropical zone the most appropriate morphoedaphic index formulations are those defined by Henderson & Welcomme (1974) based on data from a large number of tropical lakes and reservoirs. Their formulation states that, the Morphoedaphic Index (MEI), is given by the formula,

$$\textbf{MEI} = \frac{\text{Conductivity } (\mu \text{ mhos/cm})}{\text{Mean depth (meters)}}$$

Normally, mean depth is obtained by dividing the volume of the lake by its area. The relationship between MEI and potential fish yield is assumed to be characteristic for water bodies, which has similar limnological characteristics. For the tropical zone, the potential fish yield from tropical lakes and reservoirs is given by the relationship,

$$\text{Potential Fish Yield (kg/ha/yr)} = 14.3136 * \text{MEI}^{0.4681}$$

This method provided a simple estimation of potential fish yield, which can be easily accomplished, for most newly impounded reservoirs. Thus based on this relationship we have estimated that the potential fish yield from the Temenggor reservoir is 10 to 20 kg/ha/yr or a potential fish yield of about 150 - 300 tons per year for the entire reservoir. This means a potential daily catch of only 400 - 800 kg of fish per day. Thus the reservoir, while relatively large, with a surface area of 15,000 ha. will not be able to sustain a large fishery.

Other methods of relating fish yields to nutrient status and primary productivity for tropical lakes and reservoirs have been established (Meleck, 1976). Data on primary productivity or detailed analysis of nutrient status of reservoirs are not easily available. Further it is not proven that estimates of potential fish yield based on these methods are more accurate. Thus for most purposes first estimates base on the morphoedaphic index formula is adequate for planning purposes.

3.2 Creel Census

This involves studying the fishing activities within the reservoirs and then observing where they are landed. Then implement creel census at the fish landing sites. This is followed by detailed analysis of some catches where all the fishes are identified, weighed and measured. For example at Temengor Reservoir, most small-scale commercial landings are at Pulau Banding along East-West Highway. Normally information pertaining to the method of fishing and details of fishing gear were obtained from the fishers. This is only part of the daily fish catch within Temengor Reservoir. At the southern end of the reservoir near Pos Kemah some 30 - 40km south of Pulau Banding, there is a large local population of aboriginal inhabitants estimated at about 5,000 individuals. They fish daily for their own consumption as part of their own animal protein requirements. They do not market their catch, yet their daily catch is substantial. It is not easy to implement creel census on this extensive artisanal fishing.

The older large reservoirs, i.e. those constructed before 1972 have supported fairly large artisanal fisheries. Their status is very much different from the newer and much larger reservoir such as Temengor and Kenyir.

The older reservoirs such as Bukit Merah and Chenderoh have supported an artisanal fishery with a large number of participants. At Bukit Merah reservoir a total of 1,000 people from five nearby villages participated in the fishery at it peak during the 1950's and 1960's. Of these only about 100 were active fishers, the rest participated on a part-time basis. These fishers both part-time and full time use non-powered boats with a variety of fishing gears including cast nets, traps and gill nets of various mesh sizes to exploit the fisheries. The common species of fish landed in Bukit Merah reservoir are *Osteocheilus hasseltli, Cyclocheilithyes apogon, Puntius schwanenfeidii, Labiobarbus lineatus, Channa striatus, Mystus nemurus, Oxyeleotris marmoratus* and *Wallago attu.*

It has been estimated that at its peak, over 700 metric tons of fish were landed annually. Unfortunately the fisheries in Bukit Merah are faced with problems of over fishing and deterioration the water quality within the reservoir. These problems have significantly reduced the fish stocks in the reservoir. At present there are only about 15 active fishers fishing within the reservoir. Current estimate of the annual fish landing is about 100 tons. The larger fishes are sold immediate in surrounding villages and also the townships of Taiping, Selama and ljok. Most of the smaller fishes, consisting of *0. hasselti, C. apogon* and *P. schwanenfeidii,* are salted and dried before marketing.

A similar fishery exists at the Chenderoh reservoir. This fishery at Tasek Chenderoh supports a larger population from 15 nearby villages. Unlike Bukit Merah reservoir fisher people here use 5 hp. outboard motors to power their boats.

Chenderoh Reservoir supports an artisanal fishery, which is important as a source of supplementary income to the local economy (Ali & Lee 1995). The main modes of catching fish are gill netting using multi-filament nets and cast netting. The main species exploited are *P. bulu, T. thynnoides, P. schwanenfeldii, 0. melanopleurus, 0. hasselti, Osphronemus goramy* and *C. lopis*. In the late 1980s, the total annual catch and values associated with the fisheries were 25 713 kg and RM 63,179.00 (US$1.00 - RM2.60), respectively (Ali & Lee 1995).

The fisheries, however, have been declining in importance due to overfishing as well as migration of able-bodied young men to industrial urban areas. In the early 1980's Ajan (1983) reported a total of 60 fishers with an estimated harvest of 79 kg ha^{-1}. In their study, Ali and Lee (1995) identified only 30 full-time fishers in Chenderoh Reservoir with a harvest of 12.2 kg ha^{-1}. Recent studies (Khong 1995) indicated that the number of fishers have declined by almost 50% of the number identified by Ali and Lee (1995), with a concurrent drop in catch to 6.7 kg ha^{-1} level. Generally, between 8 and 16 species of fish are landed regularly by fishers. Daily catch and daily income per person show tremendous fluctuation. This explains why fishing is essentially a secondary occupation for the littoral communities of Chenderoh Reservoir.

Fishing activities within the Muda, Pedu and Temengor reservoirs are more limited. In the Muda and Pedu reservoirs, fishes such *as B. gonionotus, B. schwanefeldii, O. gorami, H. temmincki* and *P. fasciatus*, dominated the catch. In addition to these fishes, other fishes such as *Tor tambroides, H. macrolepidota, C. striata* and *O. hasselti* are sometimes caught. Only a few fishers living on the periphery of the reservoir are permitted to participate in these fisheries.

The fisheries in Temengor reservoir support a large population of aboriginal people who live on the periphery of this reservoir, especially at Pos Kemar. Subsistence fishing is mainly carried out in the southern portion of this reservoir. These rural fisher people use small bamboo rafts to fish with hand lines, traps or a small cast net. They only catch their daily dietary requirement. Recently a few fisher people using motorized boats with large gill nets have entered the fisheries at the northern portion of this reservoir.

The fisheries potential in Temengor reservoir have been estimated to be about 15 kg ha^{-1} yr^{-1}. This reservoir is large with a surface area of 15,000 ha but it is also a fairly deep reservoir with an average depth of about 38 m. Unfortunately the reservoir suffers from problems of eutrophication arising from the impoundment of a very rich tropical rainforest. The area was not logged nor was any vegetation removed prior to impoundment. Currently only the top 7 m is oxygenated, the waters below 7 m are anoxic. This may seriously restrict fisheries development within this reservoir,

The largest reservoir in Malaysia, Lake Kenyir, has a surface area of approximately 36,000 ha, with a maximum depth of 145 m, and a mean depth of 37 m. The reservoir sustains a small-scale commercial fishery as well as a popular recreational fishery, with yields estimated at approximately 20 kg/ha/year (Yusoff *et al.*, 1995). These overall low yields are the result of an anoxic hypolimnion, lack of forage in the pelagic zone and few lacustrine fish species (Yusoff *et al.*, 1995).

3.3 Experimental Fishing

In addition to the creel census, we have carried out very extensive experimental fishing using various types of gear on the majority of the large dams in Malaysia. In these studies we have use traps, electrofishing, and gillnets. The main gear we use is the gillnet of various mesh sizes. Usually we fished with mesh size 2.5 cm, 5.0 cm, 7.5 cm, 10.0 cm and 12.5 cm. The samplings were located on various sampling locations based on the objectives of the study plan. The nets were set at 1800 hr and checked at six hours intervals. All fish caught were separated based on mesh sizes, identified, weighted (g), and measured (standard and total length). For each species caught, 3-5 specimens were preserved in 10% formalin for further identification in the laboratory using standard taxonomic keys.

The main focus of our studies is to define the species diversity of the fishes in each of the dams. In addition we have carried out extensive studies on the ecology and distribution of selected species of fish. Table 3 is a list of the species of fish caught from Chenderoh reservoir, which is one of the oldest reservoirs in Malaysia (Ali, 1996). A total 67 species of fish were caught within the reservoir as oppose to only 37 species caught downstream of the reservoir.

The species diversity of one of the newer inland water bodies, Temenggor reservoir that we have studied, are as shown in Table 4. This table only records the fish diversity from the creel census as well as the catch from gillnet fishing. It does not include the data from the electrofishing experiment, as these fishes were caught from the small streams and tributaries flowing into the reservoir.

A total of 33 species from eight families were caught and identified. Cyprinidae was the dominant taxa (64 %) followed by Channidae and Bagridae, (each 9 %) whereas Belontiidae, Clariidae, Eleotridae, Gobiidae and Sisoridae make up the rest. Being a relatively new reservoir the ecology and distribution of fishes within it is still changing.

3.4 Electro Fishing

In addition to the experimental fishing using traps and fishing nets, we have carried out experimental fishing using electroshockers that have been specially modified for fishing in such soft waters. Initially six small streams (1^{st} & 2^{nd} orders) were selected for studies to determine the biodiversity and abundance of fish as these streams were postulated to be the spawning/breeding ground for several fishes within the reservoir. The streams were divided by segment (pools and riffle), nets were use to block fish from swimming upstream or downstream of the sampling site.

Table 3: Fish Biodiversity in Chenderoh Reservoir, Malaysia. (Ali, 1996)

Species	Downstream	Reservoir
Anabantidae		
Anabas testudineus (Bloch)	+	+
Belontiidae		
Betta pugnax (Cantor)	+	+
Osphronemus goramy (Lacepede)	+	+
Trichogaster trichopterus (Pallas)	-	+
Trichogaster pectoralis (Regan)	-	+
Helostomatidae		
Helostoma temminckii (Cuvier)	+	+
Pristolepidae		
Pristolepis fasciatus (Bleeker)	+	+
Bagridae		
Mystus baramensis (Regan)	+	+
Mystus nemurus (C&V)	+	+
Mystus macronemus (Bleeker)	+	+
Mystus negriceps (C&V)	+	+
Mystus vittatus (Bloch)	+	-
Belonidae		
Xenentodon canciloides (Bleeker)	+	-
Channidae		
Channa lucius (Cuvier)	-	+
Channa marulioides (Bleeker)	-	+
Channa micropeltes (Cuvier)	-	+
Channa striata (Bloch)	+	+
Cyprinidae		
Acrossocheilus deuratus (C&V)	-	+
Aristichthys nobilis (Richardson)	-	+
Barbodes gonionotus (Bleeker)	+	+
Barbodes schwanenfeldii (Bleeker)	+	+
Barbichthys laevis (Valenciennes)	+	-
Oxygaster anomalura van Hasselti/*Chela anomalura*	+	+
Ctenopharyngodon idellus (C&V)	-	+
Cyclochelichthys spp.	+	+
Cyclochelichthys heteronema (Bleeker)	-	+
Cyclochelichthys apogon (Valenciennes)	+	+
Hampala macrolepidota Kuhl & van Hassett	+	+
Hypophtatmichthys motitrix (C&V)	-	+
Labiobarbus burmanicus (Day)	-	+
Labiobarbus leptochilus (Valenciennes)	-	+
Labiobarbus lineatus Sauvage	+	+
Labiobarbus sumatrana (Bleeker)	-	+
Leptobarbus hoevenii (Bleeker)	-	+
Mystacholeucas marginatus (Valenciennes)	+	+
Neolissochilus hexagonolepis (M'Clelland)	-	+
Osteochilus hasselti (Valenciennes)	+	+
Osteochilus melanopleurus (Bleeker)	-	+
Osteochilus vittatus (C&V)	+	+
Probarbus jullieni Sauvage	-	+

Puntioptites bulu (Bleeker)	+	+
Puntius binotatus (Valenciennes)	-	+
Puntius daruphani Smith	+	+
*Puntius partipentazona (*Fowler)	-	+
Rasbora dusonensis (Bleeker*)*	-	+
Rasbora einthovenii (Bleeker)	+	+
Rasbora myersi Brittan	-	+
Rasbora cf sumatrana (Bleeker)	+	+
Thynnichthys thynnoides (Bleeker)	+	+
Tor tambra (Valenciennes)	-	+
Neolissochilus soroides (Duncker)	-	+
Cichlidae		
Oreochromis mossambicus (Peters)	-	+
Oreochromis niloticus (L)	-	+
Clariidae		
Clarias batrachus (L)	+	+
Clarias macrocephalus Guther	-	+
Eleotridae		
Oxyeleotris marmorata Bleeker	-	+
Gobiidae		
Glossogobius giuris (Hamilton)	+	+
Hemiramphidae		
Hemiranphus pogognathus (Bleeker)	+	-
Dermogenys pussilla van Hasselti	+	+
Mastacembelidae		
*Mastacembelus armatus (*Lacepede)	-	+
*Mastacembelus erythrotaenia B*leeker	-	+
Mastacembelus maculatus (Valenciennes)	-	+
Mastacembelus spp.	+	+
Notopteridae		
Chitala lopis (Bleeker)	+	+
*Notopterus notopterus (*Pallas)	+	+
Siluridae		
Ompok bimaculatus (Bloch)	+	+
Synbranchidae		
Monopterus albus Zuiew	+	+
Pangasiidae		
Pangasius micronemus Bleeker	-	+
Pangasius sutchi (Hamilton)	-	+
Tetraodontidae		
Tetraodon leiurus Bleeker	+	-
Total	**37**	**67**

Note: + present; - absent

Table 4: Fish Biodiversity in Temengor Reservoir, Malaysia.

Species	Reservoir
Belontiidae	
Osphronemus goramy (Lacepede)	+
Bagridae	
Mystus nemurus (C&V)	+
Mystus macronemus (Bleeker)/ *Mystus negriceps* (C&V)	+
Mystus planiceps (Val.)	+
Channidae	
Channa micropeltes (Cuvier)	+
*Channa striata (*Bloch)	+
Channa lucius (Bleeker)	+
Cyprinidae	
Barbodes schwanenfeldii (Bleeker)	+
Barbichthys laevis (Bleeker)	+
Balantocheilus melanopterus (Bleeker)	+
Oxygaster anomalura van Hasselti/*Chela anomalura*	+
Cyclochelichthys heteronema (Bleeker)	+
Cyclochelichthys apogon (Valenciennes)	+
Danio regia	+
Hampala macrolepidota Kuhl & van Hassett	+
Luciosoma trinema (Val.)	+
Labiobarbus lineatus (Sauvage	+
Lobocheilus rhabdoura (Fowler)	+
Macrochirichthyes macrochirus (Cuv. & Val.)	+
Mystacholeucas marginatus (Valenciennes)	+
Neolissochilus hexagonolepis (M'Clelland)	+
Osteochilus hasselti (Valenciennes)	+
Puntioptites bulu (Bleeker)	+
Puntius daruphani Smith	+
Rasbora cf sumatrana (Bleeker)	+
Thynnichthys thynnoides (Bleeker)	+
Tor tambra (Valenciennes)	+
Neolissochilus soroides (Duncker)	+
Clariidae	
Clarias teijsmanni Bleeker	+
Eleotridae	
Oxyeleotris marmoratus ((Bleeker)	+
Gobiidae	
Pseudogobiopsis oligactis (Bleeker)	+
Sisoridae	
Glyptothorax major (Boulenger)	+
Glyptothorax platypogonoides (Bleeker)	+

This list does not include fishes that were caught by electrofishing.

A total of 37 species from 14 families were identified during the study (Table 5). The northern part of Temengor Reservoir more diverse compared to the southern part of the reservoir. In this electrofishing experiments many species of fishes were caught and identified which were not present in the creel census as well as the experimental fishing using nets as the sampling gear. These were the smaller species of fish such as *Glyptothorax platypogonoides* and *Pseudogobiopsis olligactis* which were too small to be caught by gillnets. Also all the commercially exploited fish species sampled were juveniles. Thus indicating that these low order streams flowing into the reservoir were indeed important breeding grounds for these species. Further studies are being carried to confirm this finding as well as to determine the seasonal distribution and abundance of these fishes. Also we are extending the studies to include a larger number of streams flowing into the reservoir. Similar studies are being planned for the other reservoirs.

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***** *Professor Ahyaudin Ali died on 5 July 2003 soon after the initial draft of this paper was completed. We dedicate this paper to him.***

Table 5: Distribution of Fish Species from Six Small Streams at Temengor Reservoir Base on Electrofishing Studies.

Species	S. Enam	S. Telang	S. Rokan	S. Tahain	S. Temin	S. Kaik
Amblyceps mangois	-	+	-	-	+	-
Barbodes schwanenfeldii	+	-	-	-	-	-
Channa gachua	-	+	-	-	-	-
Channa lucius	-	-	+	-	-	-
Channa micropeltes	+	+	-	-	-	+
Channa striatus	+	+	+	+	-	+
Channa maruliodes	-	-	-	-	-	+
Clarias teijsmanii	+	+	-	-	-	+
Cyclocheleichthys apogon	+	-	-	+	+	-
Danio regina	+	+	+	+	+	+
Glyptothorax platypogonoides	-	-	-	+	-	-
Hampala macrolepidota	+	+	+	+	+	+
Labiobarbus cf. lineatus	-	-	-	-	+	-
Lobocheilos cf. rhabdoura	-	-	-	+	-	-
Mastacembelus armatus	-	-	-	+	-	+
Monopterus albus	+	-	+	+	+	-
Mystacoleucus marginatus	+	+	-	+	-	+
Mystus nemurus	-	-	+	-	-	-
Mystus planiceps	-	+	+	+	+	-
Mystus macronema	-	-	-	-	-	+
Nemachilus cf. Fasciatus	-	-	-	+	-	-
Neolissochilus soroides	+	+	+	+	+	-
Osphronemus gouramy	+	+	+	+	+	-
Osteochilus hasseltii	+	+	+	+	+	+
Osteochilus microcephalus	+	-	-	+	-	+
Oxyeleotris marmoratus	-	-	-	+	+	-
Parachela oxygastroides	+	-	+	-	-	-
Poropuntius deauratus	+	+	+	+	+	-
Pristolepis fasciatus	-	-	-	-	-	-
Pseudogobiopsis olligactis	+	+	+	+	+	-
Puntius binotatus	+	+	+	+	+	-
Puntius lateristriga	-	+	-	-	+	-
Rasbora caudimaculata	+	+	-	+	+	-
Rasbora sumatrana	+	+	+	+	+	+
Tetraodon cf. leiurus	-	-	-	+	-	-
Tor tambra	+	+	-	-	-	-
Xenenthodon canciloides	+	+	+	+	-	-
Total	**21**	**20**	**16**	**23**	**17**	**12**

Note: + present; - absent

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